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LIFE-HISTORIES OF SYRPHIDAE IV.

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Allograpta obliqua (Say).

(Plate XXX, Figs. 61–70).

Egg.

Elongate oval in outline, narrowing slightly to the roundly-pointed anterior end and the truncate, posterior, micropylar end. The egg is slightly inflated dorsally, flattened against the surface to which it is attached ventrally. Length about 0.8 mm., diameter 0.3 mm. (Figs. 61 and 62.)

Color chalk-white with the usual microscopic sculpturing. (Fig. 63). When highly magnified, sometimes tinted with yellowish in the depressions between the sculptures. In this case the main bodies of the projections are broader than in *Syrphus americanus* (3 to 4 times as long as broad); somewhat oval in shape, the arms thicker and not so long as in *S. americanus*; usually about fifteen around each body. The space between the bodies is about two-thirds as wide as the body. There are about 28 of these projections the length of the egg, about 55 around it transversely at the middle.

Oviposition for the first spring generation began about the middle of May. A female taken on May 17 laid 35 eggs on May 22, 13 the following day, and by May 26, when she died, had deposited nearly 100 eggs. The first of these hatched the morning of the 25th, a few others the 26th, making the duration in the egg-stage (indoors) from 2.5 to 3.5 days.

In the field I have found eggs of this species on persimmon trees (*Diospyros virginiana L*), at the University Campus the last of May, and on curled dock (*Rumex crispus L.*) at Lakeville, Ohio, June 16–18. The eggs are deposited singly and laid flat on the surface of the leaf, twig, or flower.

I know no way of distinguishing these eggs from those of related Syrphidæ except by the size, shape and the microscopic characteristics of sculpturing described above; these may prove insufficient for specific separation when the eggs of more species are known.

Larva.

When just hatched (Fig. 65) the larvæ have a length of 1.2 mm., width 0.25 mm. They are irregular in outline, nearly cylindrical, broadest near the middle; feeble and inactive. Color whitish, with a yellowish or greenish tinge. The usual small, fleshy, conical elevations are present, twelve to each segment, but the segmental bristles were not discernible, apparently absent. The posterior breathing appendages are rather prominent, longer than in a young larva of *S. americanus*, and light in color like the rest of the body. Their tips are, at first, rather remote from each other though with subsequent growth and their greater elevation above the general body surface they become contiguous. The two longitudinal fat bodies are discernible as a white line on each side of the dorsal blood-vessel which is more prominent in the posterior half of the body. The skin is faintly wrinkled transversely.

From this condition there seems to be a gradual growth until the larva, when full-grown, has reached a length of about 8 mm., width 2 mm., heigth 1.25 mm. It may then be described as follows: Shape elongate oval, but much more pointed at the anterior end when extended. The outline is somewhat irregular due to folding and wrinkling of the skin. The posterior end is rounding, truncate except for the projections of the posterior breathing organ; (Fig. 66).

Color green, very similar to that of the cabbage leaf (on which they occur commonly) with two longitudinal white stripes. This color is due to colored visceral bodies which show through the transparent skin. Along the mid-dorsal line for two-thirds the length can be seen the narrow, dark, pulsating blood-vessel, its prominence varying with different specimens. It is irregularly limited at the sides by a narrow mass of greenish, fatty globules changing gradually to whitish. This whitish adipose matter forms the two prominent longitudinal white stripes, 0.2 or 0.3 mm. wide and extending to within a few millimeters of either end where they become much attenuated. The rest of the body, except the appendages is green, darker on the sides. The breathing tubes are light brown, black at the tips where the spiracles are located.

The skin is finely papillose when magnified. The character of the visceral matter often gives the larva a very granular appearance. The segments are marked by the usual twelve bristles in a transverse row. These are light in color, not elongate and not at all conspicuous; and are the only vestiture present.

The character of the mouth-parts is more or less perfectly represented by Figure 67. Owing to the lack of favorable material I was unable to verify this drawing and it may not be perfectly accurate. The outer pair of mouth-hooks is present.

The caudal branchial appendage is prominent, elongate, about 0.5 mm. in length by 0.125 mm. in breadth; of two cylinders fused mesad except at the extreme tip where they diverge slightly(Figs. 66, *c*; 68). The usual three elongate spiracles and circular plate are present on each half. The spiracular elevation is about three times as long as broad. There is a short, spur-like spiracular spine between each two spiracles, one between the most dorsal spiracle and the plate, and one mesad from the most ventral spiracle. These spines are continued down the sides of the tube as more or less evident ridges.

Larvæ of this species were found abundant on the leaves of flowers and fruit of the persimmon (*Diospyros virginiana L.*) on the University Campus June 1 and 2*. They were feeding on the nymphs of an undetermined species of *Aleyrodidæ* which caused a curling of the leaves.

An autumn generation occurs commonly on cabbage and related plants where they are predaceous on *Aphis brassicæ*. Larvæ were taken from this host-plant at the University Farm from September 20 to October 10.

Near Lakeville in Wayne Co., larvæ were taken from curled dock, June 16–18; and at Sandusky, Ohio, from the same plant June 23. These were among colonies of *Aphis rumicus*.

The larvæ are thus seen not to be closely restricted in their food habits, attacking at least two species of *Aphididæ* and one of *Aleyrodidæ*.

These larvæ live entirely on the surface of the plants where they are found and probably do not move farther than is necessary to secure their food. On the persimmon the larvæ were found on the flowers, but chiefly on the leaves, especially under the rolled up edges, where the Aleyrodid nymphs were commonest. On *Rumex* they were to be found mostly in the spikelets and on the under side of the leaves where the plant lice occur.

Whatever the host, the method of feeding is the same. The body-wall of the aphid is pierced by the mouth parts and the soft contents picked and sucked out while the head is pushed farther and farther inside the victim's skin.

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*I am indebted to my fellow-student, Mr. J. Lyonel King, for first calling my attention to these specimens.

The larvæ have no defensive structures so far as I am aware. Their color is probably of a great deal of protective value to them. On cabbage and on dock they very closely resemble the color of the leaves. On cabbage they are frequently in a position among the leaves inaccessible to predaceous enemies; on dock the under side of the leaf is not a conspicuous position; and on persimmon they are most commonly closely rolled about by the curling leaf.

Numerous larvæ of the autumn generation on cabbage are parasitized by the small Ichneumonid, *Bassus lætatorius* Fabr.†

Pupa.

Dimensions, average of eight: Length about 5.25 mm., maximum breadth 2.5 mm., maximum height 2.3 mm. This neglects the breathing tubes at the posterior end of the body which may project 0.5 mm. farther posteriorly or be directed more dorsally.

The puparium is broadest and deepest in front of the middle, the anterior end bulbous; strongly and evenly depressed and compressed to the posterior end, the posterior elevation very gradual. (See Figs. 69 and 70).

The color in this stage changes very decidedly during the development of the nymph within the translucent puparium. The color is not resident in the pupal envelope but due almost entirely to the inclosed matter. Consequently at first the colors are those of the larva—light pea-green with a brownish remnant of the dorsal blood vessel and, at the sides of this, the two whitish lines. The flattened posterior end of the puparium, including the breathing tubes, however, is light testaceous brown, the tips about the spiracles black. Midway on the length of the breathing appendages is a dark brown ring.

As the pupa developes within, the color changes, gradually losing all trace of the green and assuming more and more the colors of the adult. The first thing to be noticed is the reddish brown color of the eyes replacing the green in the anterior third of the pupa. Later the black and yellow abdominal markings become apparent.

The puparium is smooth, bare; the segmental spines inconspicuous. The breathing tubes as in the larva, prominent subcylindrical, the tips around the spiracles becoming black. The wrinkles of the skin often remain rather prominent.

Pupæ were found on persimmon June 1 to 5; on *Rumex* more or less continuously from the latter part of June, through July to August; and on cabbage from September 15 to October 15. In captivity a number of pupæ were formed between September 21 and October 1.

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†See THE OHIO NATURALIST, Vol. XII, No. 5, pp. 483, 484, Mar., 1912.

The duration in the pupal stage varied in captivity from 3.5 to 5.5 days in the case of those taken from persimmon in the spring, while in Autumn in specimens from cabbage the duration in the pupal stage was in some cases as much as 10 days.

These pupæ are fastened by a viscid substance secreted by the anal glands of the larva which, in drying, glues them to various parts of the host-plant of the aphids among which they live. They attach to the flowers and in the curls of the leaves of persimmon, in leaf-axils, or flower spikes of *Rumex* and on cabbage among the outer leaves. In jars they attach to the cloth cover, the glass, or to leaves enclosed, apparently with no discretion.

The body shortens and thickens and the larval skin inflates and hardens in the usual manner. Within this puparium profound changes take place which culminate in the completely formed nymph, which has only to spread its wings and harden, after bursting out of the pupa case, to form the perfect fly.

Adult.

Description after Williston, Synop. N. A. Syrph., 96, 1886. (See Fig. 64.) "♂ ♀. Length, 6 to 7 mm. Face yellow, often with a bluish reflection, slightly brownish on the tubercle. Frontal triangle yellow; front in the female shining black on the vertex, continued as a broad stripe (broadest below) to the antennæ; on the sides the yellow of the face continues up along the eyes nearly to the ocelli. Antennæ reddish-brown, blackish on the upper part of the third joint. Thorax deep shining green, on the sides with a yellow stripe, reaching from the humeri to the suture, where it is sharply truncate; post-alar callosity also yellow. Scutellum wholly light yellow, faintly reddish on the disk; pile black. Abdomen black, or brown; first segment, except a slender transverse spot on each side behind, yellow; second segment with a slender yellow anterior fascia, and a broader one in the middle, about a third of the width of the segment, straight and but slightly widened at the sides; third segment with a broad arcuate band, not quite touching the posterior angles on the sides; fourth segment with two slender parallel stripes, leaving a slender black stripe between them, on each side a broader, oblique, oval spot, touching, or narrowly separated fron the anterior end of the yellow longitudinal stripe, and reaching to the posterior angles; fifth segment similar, but the side spots less oblique. Legs light yellow; last three joints of all the tarsi, the hind tibiæ, except the base and a middle ring, and a ring on outer part of hind femora, brownish. Wings hyaline, veins black."

Syphaerophoria cylindrica (Say).

(Plate XXX, Figs. 71–78).

Egg.

Length 0.9 mm., diameter 0.3 mm. Elongate oval, less pointed anteriorly than that of *Allograpta obliqua* but scarcely discernible from the latter, or from egg of *Syrphus americanus*, except possibly by microscopic examination.

Color chalk-white, sculpturing very similar to that of *Allograpta obliqua*. The projecting bodies however, appear, on the whole, to be shorter and broader than in that species, about two or three times as long as broad; distance between any two bodies about one-half the width of the body itself; number of arms around it 12 to 20, rather short, not much branched. Many of them ending at half the distance across the intervening space. Numbers of bodies around the egg at the middle about 50; number the length of the egg from pole to pole, very close to 30.

A female of this species taken on May 8, 1911, over grass, was confined and fed sweetened water. Four days later, May 12, 22 eggs were laid, and two the following day. None of these eggs hatched up to May 22, and were probably infertile, though it is possible that other conditions might have prevented normal development. Another female taken on May 13 laid only 2 eggs May 14; and a third, after being enclosed for some days, oviposited several dozen eggs on May 31. None of these hatched.

The eggs were deposited in the usual manner, the posterior ventral portion being glued to the surface. These little glistening white eggs seem to have no method of natural protection except the egg-shell which is leathery rather than fragile.

Larva.

Length 9 to 10 mm., height 1.25 mm., width 2.25 mm. Elongate oval, tapering at anterior end, somewhat truncate except for respiratory appendage at posterior end, depressed. Outline irregular, dorsal integument much wrinkled transversely, and with lateral, longitudinal carinæ. (Fig. 76).

Color pea-green with two, narrow, longitudinal, white stripes, laterad of and paralleling the rather conspicuous dark heart line. These white stripes and other coloring produced as in Allograpta; the stripes attenuated and confluent a little before the anterior end, not reaching the respiratory appendage posteriorly.

Respiratory appendage brownish black at the tip. The skin is papillose, bare except for the usual segmental bristles which are here short, light-colored and inconspicuous. There are a number

of poorly defined pro-leg-like projections of the body on the ventral side. The mouth-parts (Fig. 77) consist of three pairs of hooklets in addition to the pair of jaws. One pair of hooklets is short and heavy, triangular, lateral in position (Fig. 77, *d*), the other two pairs, situated close beside the jaws (*c*), are slender, elongate, slightly curved. The jaws (*b*) are of the usual type but U-shaped rather than V-shaped, the shoulders rather prominent, with a median, terminal, pointed projection.

The antennæ (Fig. 77, *a*) and anterior spiracles are rather well elevated. The latter on a fleshy base with a prominent constriction beyond the middle showing at the apex a small number of rounded teeth or lobes about three larger and three smaller ones. (Figs. 74, 75).

The shape, color and general appearance is very similar to the larva of *Allograpta obliqua*. So much so in fact that I was unable for a long time to distinguish the two and was being constantly baffled by the issuance of adult *Sphærophoria* from my stock of supposedly *Allograptid* larvæ and pupæ. There is an indefinable difference in the naked eye appearance as near as I can express it, due to the more finely and evenly granular appearance of the fat bodies visible through the dorsal wall in *Sphærophoria*. But I am not sure that this is constant.

The two species can, however, be very certainly and definitely separated on the basis of the posterior respiratory appendages. These are about the same length and other dimensions; the difference lies in the distal end. As described in *Allograpta obliqua* the two tubes are slightly divergent at the tip making them broader here than at mid-length, and bear between each two spiracles a short, but readily visible, spur-like elevation continued as a slight ridge down the side of the tube. Now in *Sphærophoria cylindrica* the end of the tube is very nicely and evenly rounded off; the spiracles very slightly elevated; the two tubes slightly emarginate but not at all divergent, and all trace of inter-spiracular spines or projections lacking. With the aid of a good hand lens one can always separate these two species at a glance when the characters have once been fixed in mind. (See Figs. 72 and 73 and compare Figs. 66 and 68).

On June 4th larvæ of this species were taken from among *Aphis brassicæ* in a greenhouse on the University Campus. At Sandusky, larvæ were found commonly on curled dock (*Rumex crispus*) June 20th and later. At Lakeville, larvæ were taken from thistle (*Carduus sp.*) among *Aphis sp.* August 27, 1911. In Autumn they are rather common on cabbage, in gardens during September. *Aphis brassicæ* Linn. seems to be their favorite prey, though they are not restricted to this species, and may be found to be rather ubiquitious.

As in *Allograpta obliqua* these larvæ are colored like the leaves on which they commonly feed and this is probably of some protection to them. They are also parasitized by *Bassus lætatorius*.

Pupa.

Dimensions, average of six: Length, neglecting the posterior respiratory appendage, 5.3 mm., height 2.05 mm., width 2.1 mm. In general shape, color, and appearance so similar to *Allograpta obliqua* as scarcely to permit of separate description. The puparium is generally less strongly elevated posteriorly, (See Fig. 78*cf*, Fig. 70.) The characters of the posterior respiratory appendages however remain as in the larva and will always serve to distinguish the species from *A. obliqua*.

Pupation was observed to occur in an open greenhouse Columbus, Ohio, June 5, 1911. On *Rumex crispus*, Sandusky, the 23rd of June and later, and from the middle of September to the middle of October on cabbage. The pupæ were glued to the more or less exposed surfaces of the leaves among which the larvæ had fed. The duration in the pupal stage (indoors) was 5 to 7 days.

Adult.

The following description modified after Williston, Synop. N. A. Syrph. applies to the adults reared from the larvæ and pupæ described above. (See Fig. 71).

♂. Length, 6 to 8 mm. Face and front light yellow, shining; tubercle and anterior oral margin somewhat fuscous. Antennæ reddish yellow, sometimes brownish above on third joint. Dorsum of thorax dark greenish olivaceous, somewhat shining, with an abbreviated lateral stripe reaching only to the suture, or very indistinct back of the suture; two more or less prominent grayish pollinose stripes on the anterior part near the middle line; pleuræ deep shining, somewhat bluish black, with light yellow spots as follows: a large one under the base of the wing, irregular in shape, imperfectly divided, covering the pteropleura and parts of the mesopleura and metapleura; and three smaller ones, one above the base of each coxa; which, except the front one, may be continuous with the larger spot; scutellum sulphur yellow. Abdomen slender; first segment black except on the sides; second segment with a broad yellow cross-band in the middle, and a brown or black band half its width in front and behind, not reaching the lateral margin. Remaining abdominal segments more or less variable; third segment narrowly brown or blackish in front and behind, elsewhere reddish yellow; fourth segment yellow and obscurely brownish; fifth segment and hypopygium wholly reddish yellow, the latter globose and with a tuft of pile below in front. Legs yellow including the coxæ, the tarsi more or less infuscated. Wings nearly hyaline, not exceeding the abdomen.

♀. Front shining black, yellow on the sides below; yellow lateral stripes of thorax extending only to the suture. Abdomen moderately broad, shining black with the extreme lateral margins continuously yellow and a moderately arcuate, entire, yellow band, reaching the yellow on the sides, on each of the segments from two to four inclusive. These bands cover about one-third the length of the segment. Fifth segment with a similar but slenderer yellow band interrupted in the middle. Sixth segment yellow with some black on the disk. In other respects as in the male.

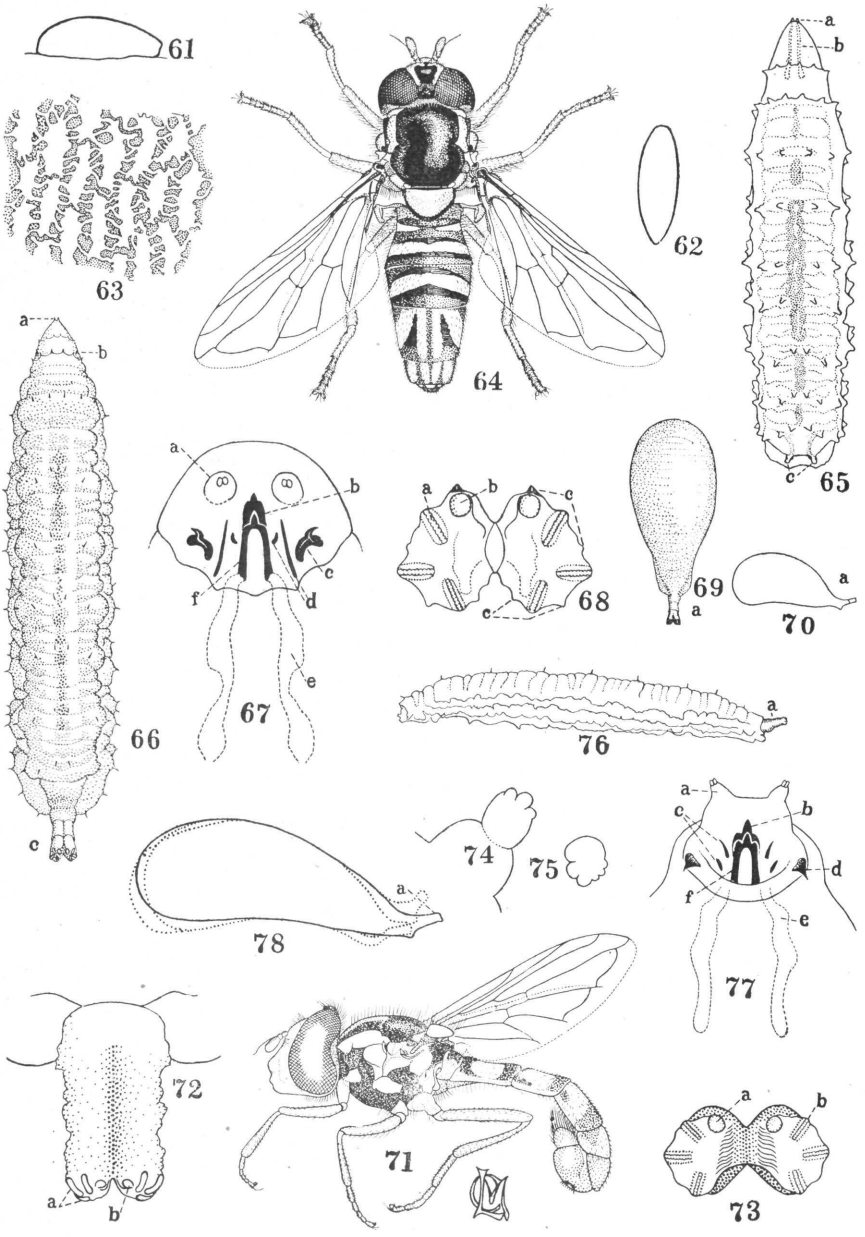
EXPLANATION OF PLATE XXX.

Figures 61–70 *Allograpta obliqua* (Say).

Fig. 61. Egg from the side x 20.
Fig. 62. Dorsal view of egg x 20.
Fig. 63. A small part of the surface of egg-shell showing sculpturing, highly magnified.
Fig. 64. Adult ♀ about 7 times natural size.
Fig. 65. Larva, 12–24 hours after hatching x 50; *a*, antenna; *b*, internal oesophageal framework; *c*, posterior respiratory organs.
Fig. 66. Mature larva x 9; *a*, antenna; *b*, position of anterior spiracles; *c*, posterior respiratory appendages.
Fig. 67. Antero-ventral view of the head of the larva, much enlarged; *a*, antenna; *b*, upper jaw;*c*, outer pair of mouth-hooks; *d*, the two pairs of lateral mouth hooklets; *e*, chitinous oesophageal framework (internal); *f*, lower jaw.
Fig. 68. End view of posterior respiratory organ x 200; *a*, one of the six elongate spiracles, *b*, the dorsal, circular plate; *c*, *c*, the interspiracular spines.
Fig. 69. Dorsal view of puparium x 5; *a*, posterior respiratory appendage.
Fig. 70. Outline of puparium from the side x 3.5; *a*, posterior respiratory appendage.

Figures 71–78 *Sphaerophoria cylindrica* (Say).

Fig. 71. Drawing of the adult male from the side x 7.
Fig. 72. Terminal part of mature larva x 60, showing respiratory apparatus; *a*, slit-like spiracles; *b*, dorsal circular plate.
Fig. 73. End-view of posterior respiratory appendage x 120; lettering as in Fig. 72.
Fig. 74. Side view of anterior respiratory appendage, highly magnified.
Fig. 75. The same from the end, showing teeth-like lobes.
Fig. 76. The larva from the side x 5; *a*, posterior respiratory appendage.
Fig. 77. Antero-ventral view of head segments, much enlarged; *a*, the antenna; *b*, the upper jaw; *c*, the two pairs of mouth-hooks close beside the jaws; *d*, the outer pair of mouth-hooks; *e*, chitinous oesophageal framework (internal); *f*, lower jaw.
Fig. 78. Outline of puparium from the side x 7.5; the dotted lines indicate several variations in the shape of puparia.



METCALF on "Life-Histories of Syrphidae IV."